

## **CHAPTER 4**

### **NOISE**

## NOISE ELEMENT

### 4.1 Authority and Purpose

The purpose of this Noise Element is to help protect the health and welfare of the planning area and community by promoting development which is compatible with accepted noise standards. In addition, the Noise Element mitigates noise conflicts where they presently exist and minimizes future noise conflicts by the adoption of policies and implementation measures designed to achieve land use compatibility for proposed development.

Section 65402(b) of the California Government Code requires that a Noise Element be prepared as part of all City General Plans. This State law requires that a jurisdiction, through its Noise Element, identify and work toward elimination of noise problems in the community.

The Government Code Section 65302(g) specifically requires:

A noise element in quantitative, numerical terms, showing contours of present and projected noise levels associated with all existing and proposed major transportation elements. These include but are not limited to highways and freeways, ground rapid transit systems, and ground facilities associated with all airports.

These noise contours may be expressed in any standard acoustical scale which includes the magnitude of noise and frequency of its occurrence. The recommended scale is sound level A, as measured with A-weighting network of a standard sound level meter, with corrections added for the time duration per event and the total number of events per 24-hour period.

Noise contours shall be shown in minimum increments of five decibels and shall be continued down to 65 dBA. For regions involving hospitals, rest homes, long-term medical or mental care, or outdoor recreational areas, the contours shall be continued down to 45 dBA.

Conclusions regarding appropriate site or route selection alternatives or noise impact upon compatible land uses shall be included in the General Plan.

The state, local, or private agency responsible for the construction or maintenance of such transportation facilities shall provide to the local agency producing the plan, a statement of the present and projected levels of the facility, and any information that was used in the development of such levels.

This Noise Element recognizes the guidelines established by the State Office of Noise Control and the State Department of Health Services and analyzes current and projected noise levels for highways and major city roadways, railroad operations, aircraft, local industrial plants and other ground stationary sources identified by the local government as contributing to the community noise environment.

The noise level contours and tables presented in this element are required to be used as a guide for establishing a pattern of land uses in the Land Use Element that minimizes the exposure of community residents to excessive noise. The noise element is in a sense a supplementary element in that its standards and proposals are to be superimposed upon, or incorporated with those of other element plans. In addition to required conformance with the Land Use Element, this Noise Element is in conformance to other elements of the City General Plan, particularly the Housing Element, Safety Element, Circulation Element, Open Space and Conservation Element.

This element is also consistent with the Placer County General Plan Noise Element and other local and regional planning documents. The standards and goals of this plan element will also have reference value in the assessment of noise impacts upon the environment which may result from proposed public and private development projects.

Present and future noise levels are shown in this document. They are stated in terms of day/night sound level (Ldn). This is the preferred format for implementing the State of California's Noise Insulation Standards. The following section of this element presents an explanation of the concepts of environmental noise and how it is evaluated.

## **4.2 Background**

### **4.2.1 Effects of Noise on People**

#### **Hearing Loss**

When sounds are too intense and prolonged, the hearing receptor cells, or "hair cells", can be damaged. The inner ear (cochlea) is a coiled tube about 34 millimeters long, containing about 17,000 hair cells. Hearing loss can occur along all parts of the cochlea. Thus, the degree of hearing loss depends not only on the injury at any one location, but upon the spread of hearing loss in the inner ear. Hearing loss usually occurs above the speaking ranges and spreads downward. Damage can, therefore, be substantial before hearing loss is noticed.

Most experts believe that noise levels of 70 dBA or more contribute to loss of hearing over a lifetime. Clear evidence is available that noises above 80 dBA can contribute to inner ear damage and eventually hearing loss if they are frequently and regularly encountered. Trucks, trains, sports cars, and motorcycles all exceed 80 dBA at 50 feet. Amplified music at close range may reach 120 dBA. In industry, excessively loud machinery is common.

#### **Speech and Sleep Interference**

Speech interference begins occurring at about 40-45 dBA and becomes severe at 60 dBA and above. Excessive background noise can reduce the amount and quality of verbal exchange and adversely affect education, family lifestyles, occupational efficiency, and quality of one's relaxation.

To protect a person from sleep interference sound levels should not rise above 35-40 dBA. Whether a person is actively awakened by a particular noise will depend upon noise levels, characteristics of noise, stage of sleep, the person's motivation to awaken, age, sex, and so on. Elderly people and persons who are ill are particularly susceptible to sleep interference caused by noise.

### **Stress Inducement**

Noise as a source of stress is a likely contributor to what many medical authorities believe are stress related diseases such as ulcers, high blood pressure, heart disease, and arthritis. As a source of stress, noise may also be a contributing factor in mental illness, anxiety, and psychological distress. This distress, in turn, can lead to instability, sexual impotency, headaches, nausea, general anxiety, and changes in general mood.

### **Performance and Learning**

Work performance can be adversely affected by noise through distraction and through the physical reactions previously described. While noise does not seem to have an affect on overall work productivity, it can reduce accuracy of work, particularly of complex tasks, and inhibit learning. Even if it does not do this, the price may be increased fatigue, distraction, and irritability on the part of the employee or student. Studies conducted in Europe recommend 55 dBA as an upper limit for peak-interfering noise in classrooms.

### **Annoyance**

Many factors affect how annoyed people will be by environmental noise. A first consideration is the characteristics of the noise itself including loudness, duration, steadiness, or whether it contains speech or music. Secondly, background noise levels affect the determination of how intrusive a particular noise is perceived. Thirdly, the time of day and seasonal variations can make a difference. People are most likely to be disturbed at home, at night, and during warm weather.

The number of people disturbed by noise generally goes up as noise levels increase. Predicting annoyance responses to noise in particular situations is difficult. Individuals who complain are generally not unusually physically sensitive to loud sounds. They do tend to have higher incomes and levels of education than those who do not complain. Community wide annoyance responses also depend on leadership within the community and a total sense of community by population.

Complaints are not, then, a very good criteria to apply in setting protective noise standards. As a result, criteria based on the harmful and disturbing effects of noise on persons have emerged as more objective, measurable, and protective approaches to the problem of setting noise standards.

#### 4.2.2 Measurement and Management of Environmental Noise

Sound travels through the air in waves of minute air pressure fluctuations caused by some types of vibrations. In general, sound waves travel away from the noise source as an expanding spherical surface. The energy contained in a sound wave is consequently spread over an increasing area as it travels away from the source. The result is a decrease in loudness at greater distances from the noise source.

The human ear is subject to a wide range of sound intensities and people hear changes in sound in proportion to those intensities. The *decibel* (dB) scale is a logarithmic scale used to compress this range. The threshold of human hearing corresponds roughly to 0 dB. Figure 4-1 shows typical sound levels encountered in the environment. The "A" weighting scale, that which most closely resembles human hearing, is used in this plan and is noted by the symbol **dBA**.

Varying noise levels are often described in terms of the equivalent constant decibel level. Equivalent noise levels (**Leq**) are used to develop single value descriptions of average noise exposure over various periods of time. Such average exposure ratings often include additional weighting factors for annoyance potential because of time of day or other considerations. In this general plan, the time varying character of environmental noise is described as **Ldn**. This is a statistical weighting of daytime and nighttime noises and is used as the basis of noise impact evaluation and for land use planning criteria.

*Ambient noise levels* constitute the composite from all sources far and near. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

Parameters used when estimating traffic noise relate to the traffic, the roadway, and the receiver. Traffic parameters affecting noise are the number and type of vehicles passing a point during a particular time period and the average speed of the vehicles. Roadway variables include its surface, gradient, and geometry.

Highway noise increases as the number and average speed of automobiles on it increases. For example, if the automobile traffic volume doubles, the noise level from those autos increases by about 3 dBA. However, if the speed decreases to half, the noise level from autos decreases by about 6 dBA. The engine exhaust system and tire roadway interaction contribute prominently to overall automobile noise.

Truck noise behaves differently. Noise from tires, exhaust, intake engine and gears all contribute to the total noise environment. An average truck generates A-levels about 15 dBA higher than the average car. The condition of the trucks muffler is particularly important. Another significant difference between the two vehicle sources is that the main noise from autos is from tires, whereas from heavy trucks it is the exhaust stack.

When distance is the only factor considered, sound levels form an isolated noise source

will typically decrease by about 6 dB for every doubling of distance from the source. When the noise source is essentially a continuous line (e.g., vehicle traffic on a highway), noise levels decrease by about 3 dB for every doubling of distance.

Receiver parameters are those which affect the relationship of the receiver's position to the vehicle roadway noise source. The distance between the observer and the highway is the most significant factor. The greater the distance, the lower the noise level. Doubling the distance from the highway (for example going from 100 to 200 feet) reduces the average traffic noise at the receiver's position by about 4 to 6 dBA.

Railroad noises may also be measured and compared using Ldn levels as a basis for evaluation. Railway noise is produced by the combination of diesel engine noise and railway car noise. Other variables are distance to the receiver, number of train operations, speed of trains and numbers of cars per train. Engine air horns and grade crossing warnings are treated as single event noises.

Noise levels are mapped using **Noise Exposure Contours**. They are lines drawn about a noise source which indicate constant energy levels of noise exposure. The contours are usually drawn in Ldn levels.

Numerous criteria have been developed over the years for assessing the acceptability of community noise levels, including many more or less complicated procedures for assessing annoyance.

**Figure 4-1  
Common Indoor and Outdoor Noise Levels**

Common Outdoor Noise Level	Noise Level dBA	Common Indoor Noise Levels
	110	Rock Band
	---	
Jet Flyover at 1,000 feet	---	
	100	
	---	Inside Subway Train (New York)
Gas Lawn Mower at 3 feet	---	
	90	
Diesel Truck at 50 feet	---	Food Blender at 3 feet
	---	
Noisy Urban Daytime	80	Garbage Disposal & Shouting at 3 feet
	---	
	---	
Gas Lawn Mower at 100 feet	70	Vacuum Cleaner at 10 feet
	---	
Commercial Area	---	Normal Speech at 3 feet
	60	
	---	Large Business Office
	---	
Quiet Urban Daytime	50	Dishwasher Next Room
	---	
	---	
	40	Small Theater, Large Conference Room
Quiet Urban Nighttime	---	
Quiet Suburban Nighttime	---	Library
	30	
	---	Bedroom at Night
Quiet Rural Nighttime	---	Concert Hall (Background)
	20	
	---	
	---	Broadcast & Recording Studio
	10	
	---	
	---	Threshold of Hearing
	0	

Note: A ten (10) decibel increase in sound level on dBA scale doubles the apparent loudness or annoyance of the sound.  
Source: "Guide on Evaluation and Attenuation of Traffic Noise", American Association of State Highway and Transportation Officials.

### Federal Agency Guidelines

The Federal Noise Control Act of 1972 (Public Law 92-574) established a requirement that all federal agencies must administer their programs in a manner that promotes an environment free from noise that jeopardizes public health or welfare. The U.S. Environmental Protection Agency (EPA) was given the responsibility for providing

information to the public regarding identifiable effects of noise on public health and welfare, publishing information on levels of environmental noise that will protect the public health and welfare with an adequate margin of safety, coordinating federal research and activities related to noise control, and establishing federal noise emission standards for selected products distributed in interstate commerce. The Federal Noise Control Act also directed that all federal agencies comply with applicable federal, state, interstate, and local noise control regulations.

Although the EPA was given major coordination roles regarding public information and federal agencies, each federal agency retains authority to adopt noise regulations pertaining to agency programs. The EPA, however, can require other federal agencies to justify their noise regulations in terms of the Federal Noise Control Act policy requirements. The Occupational Safety and Health Administration retains primary authority for setting workplace noise standards.

In response to the requirements of the Federal Noise Control Act, the EPA has identified indoor and outdoor noise limits to protect public health and welfare (e.g. hearing damage, sleep disturbance, and communication disruption). Ldn values of 55 dB outdoors and 45 dB indoors are identified as desirable to protect against speech interference and sleep disturbance for residential, educational and health care areas. The noise level criterion to protect against hearing damage in commercial and industrial areas is identified as a 24-hour Leq value of 70dB (outdoors and indoors).

The Federal Highway Administration (FHWA) has adopted criteria for determining whether the noise impacts associated with federally funded highway projects are sufficient to justify noise mitigation actions (47 FR 131: 29653-29656). The FHWA noise abatement criteria are based on peak-hour Leq noise levels, not Ldn or 24-hour Leq values. The peak 1-hour Leq criteria for residential, educational, and health care facilities are 67 dB outdoors and 52 dB indoors. The peak 1-hour Leq criterion for commercial and industrial areas is 72 dB (outdoors). These criteria would be used if the City of Colfax were to participate in federally funded highway projects.

The relationship between peak-hour Leq values and associated Ldn values depends upon the distribution of traffic over the day. A peak-hour Leq value cannot be converted precisely to an Ldn value. However, in areas with heavy traffic, the peak-hour Leq is typically 2 to 4 dB lower than the daily Ldn value. In less heavily developed areas, the peak-hour Leq is often equal to the daily Ldn value. For rural areas with little nighttime traffic, the peak-hour Leq value will often be 3 to 4 dB greater than the daily Ldn value. The average difference between the peak-hour and the Ldn level in Colfax is about 3.1 dB.

The U.S. Department of Housing and Urban Development has established guidelines for evaluating noise impacts on residential projects seeking financial support under various grant programs (44 FR 135:40860-40866). Sites are generally considered acceptable for residential use if they are exposed to outdoor Ldn values of 65 dB or less. Sites are considered "normally unacceptable" if they are exposed to outdoor Ldn values of 65-75 dB and

completely unacceptable if outdoor Ldn values are above 75 dB. These criteria must be considered when the City of Colfax evaluates potential sites for federally funded housing projects.

### **State Guidelines and Local Standards**

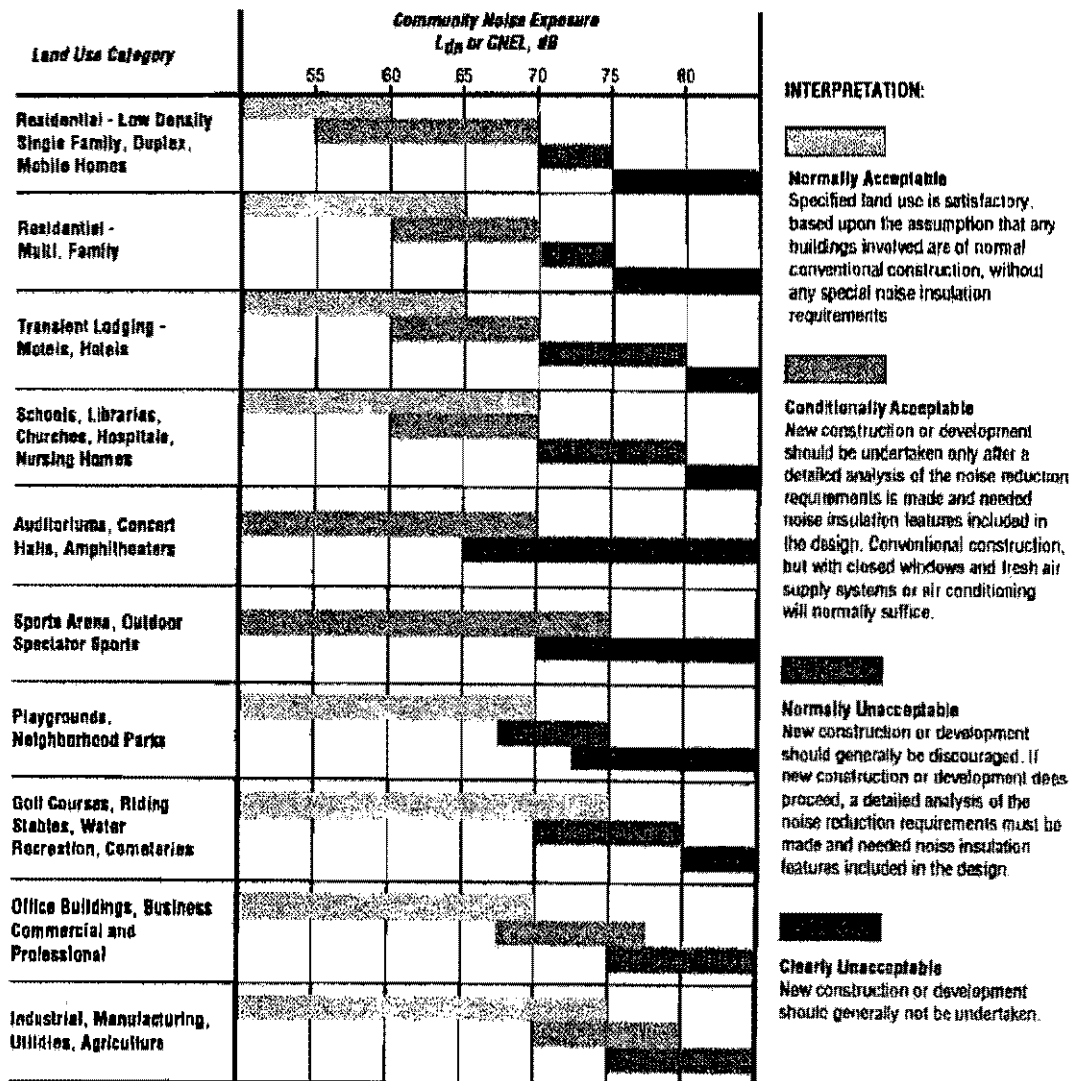
The California Department of Health Services (DHS) has published guidelines for the preparation of noise elements of local general plans. This city noise element is in compliance with those guidelines. The Guidelines include a noise level/land use compatibility chart, Figure 4-2, that categorizes various outdoor Ldn ranges into four compatibility categories (normally acceptable, conditionally acceptable, normally unacceptable and clearly unacceptable), depending upon land use. For some land uses, the chart shows overlapping Ldn ranges of two or more compatibility categories. The City of Colfax, by adoption of this element, has adopted these standards for new development.

Changes in the Land Use Element must consider these standards when development is proposed. The increased residential density in the downtown area will increase the noise level, but if mitigation measures in this element are followed the standards can be followed. With the changes in the industrial land use areas in the City, conflicts in noise levels between residential and industrial areas can be eliminated. Any use permit granted that has the potential for excessive noise levels in noise sensitive areas, must have noise level limits and mitigation measures required for the use permit.

This Colfax General Plan Noise Element identifies the normally acceptable range for low-density residential uses as less than 60 dB, while the conditionally acceptable range is 55-70 dB. The normally acceptable range for medium and high-density residential uses is identified as Ldn values below 65 dB, while the conditionally acceptable range is identified as 60-70 dB. For educational and medical facilities, Ldn values below 70 dB are considered normally acceptable, while Ldn values of 60-70 dB are considered conditionally acceptable. For office and commercial land uses, Ldn values below 70 are considered normally acceptable, while Ldn values of 67.5 to 77.5 are categorized as conditionally acceptable.

The California Department of Housing and Community Development has adopted noise insulation performance standards for new hotels, motels, and dwellings other than detached single family structures (24 Cal. Adm. Code 25-28). These standards require that "interior Ldn with windows closed, attributable to exterior sources, shall not exceed an annual Ldn of 45 dB in any habitable room." These standards are required to apply to conditions for issuance of building permits for all such multi-family dwellings to be located in Colfax.

**Figure 4-2**  
**Land Use Compatibility for Community Noise Environments**



Source: State of California, Office of Planning and Research 1990 General Plan Guidelines

The California Vehicle Code includes limits for noise emissions from motor vehicles. Enforcement of these sections (Figure 4-3) is done by the California Highway Patrol and local law enforcement agencies.

#### California Vehicle Code 27160 Motor Vehicle Noise Limits

- (a) No person shall sell or offer for sale a new motor vehicle which produces a maximum noise exceeding the following noise limit at a distance of 50 feet from the centerline of travel under test procedures established by the department:
- (b) Test procedures for compliance with this section shall be established by the department, taking into consideration the test procedures of the Society of Automotive Engineers.

**Figure 4-3  
Motor Vehicle Noise Limits**

1) Any motorcycle manufactured before 1970	92 dBA
2) Any motorcycle, other than a motor-driven cycle, manufactured after 1969, and before 1973	88 dBA
3) Any motorcycle, other than a motor-driven cycle, manufactured after 1972, and before 1973	86 dBA
4) Any motorcycle, other than a motor-driven cycle, manufactured after 1974, and before 1978	80 dBA
5) Any motorcycle, other than a motor-driven cycle, manufactured after 1977, and before 1988	75 dBA
6) Any motorcycle, other than a motor-driven cycle, manufactured after 1987	70 dBA
7) Any snowmobile manufactured after 1972	82 dBA
8) Any motor vehicle with a gross vehicle weight rating of 6,000 pounds or more, manufactured after 1972, and before 1975	88 dBA
9) Any motor vehicle with a gross vehicle weight rating of 6,000 pounds or more, manufactured after 1972, and before 1975	86 dBA
10) Any motor vehicle with a gross vehicle weight rating of 6,000 pounds or more, manufactured after 1974, and before 1978	83 dBA
11) Any motor vehicle with a gross vehicle weight rating of 6,000 pounds or more, manufactured after 1977, and before 1988	80 dBA
12) Any motor vehicle with a gross vehicle weight rating of 6,000 pounds or more, manufactured after 1987	70 dBA
13) Any other motor vehicle manufactured after 1965, and before 1973	86 dBA
14) Any other motor vehicle manufactured after 1972, and before 1975	84 dBA
15) Any other motor vehicle manufactured after 1974, and before 1978	80 dBA
16) Any other motor vehicle manufactured after 1977, and before 1988	75 dBA
17) Any other motor vehicle manufactured after 1987	70 dBA

### 4.3 Existing Conditions and Noise Issues in Colfax

The State Office of Planning and Research (OPR) Noise Element Guidelines require that major noise sources be identified and quantified by preparing generalized noise contours for current and projected conditions. Significant noise sources include traffic on major roadways and highways, railroad operations, airports and heliports, and representative industrial activities and fixed noise sources.

Noise modeling techniques, noise measurements and use of existing measurement data were used to develop generalized Ldn noise contours for the major roadways, railroads and fixed noise sources in the study area for existing conditions (Figure 4-4, Figure 4-5).

Noise modeling techniques use source-specific data including average levels of activity, hours of operation, seasonal fluctuations, and average levels of noise from source operations. Modeling methods have been developed for a number of environmental noise sources including roadways, railroad line operations, industrial plants and airports. Such methods produce reliable results as long as data inputs and assumptions are valid. The modeling methods used in this report closely follow recommendations made by the State Office of Noise Control, and were supplemented where appropriate by field-measured noise level data to account for local conditions. The noise exposure contours are based upon annual average conditions. Because local topography, vegetation or intervening structures may significantly affect noise exposure at a particular location, the noise contours should not be considered site-specific.

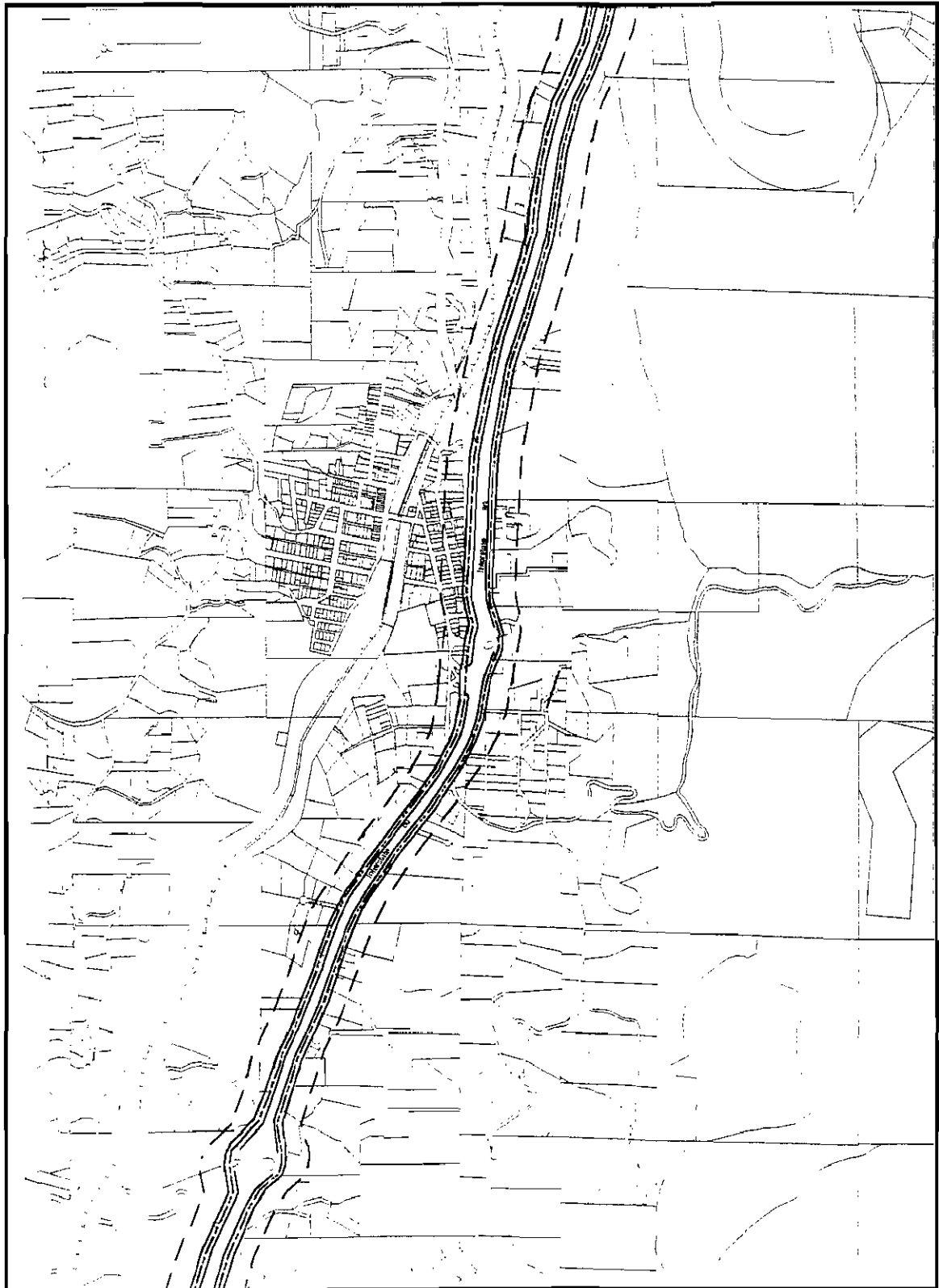
A community noise survey was conducted to describe existing noise levels in noise-sensitive areas within the Plan Area so that noise level performance standards could be developed to maintain an acceptable noise environment.

#### Roadways

The Federal Highway Administration (FHWA) Highway Traffic Noise Predication Model (FHWA-RD-77-108) was used to develop Ldn contours for all highways and major roadways in the Plan Area. The FHWA Model is the analytical method presently favored for traffic noise prediction by most state and local agencies, including Caltrans. The FHWA Model predicts hourly Leq values for free-flowing traffic conditions, and is generally considered to be accurate within 1.5 dB. To predict Ldn values, it is necessary to determine the hourly distribution of traffic for a typical 24-hour day and to adjust the traffic volume input data to yield an equivalent hourly traffic volume.

At various times throughout the Fall of 1997, noise levels were recorded in several locations in Colfax. Figure 4-6 shows the location of monitoring stations. Both peak hour and 24 hour levels were recorded in 15 minute samples with a 13 Bruel and Kjar (B&K) Model 166 noise classifier which was calibrated before each set of readings was taken.

Figure 4-4  
Interstate 80 Noise Contours



Legend

- 72 dB at 50 feet - - - -
- 63 dB at 100 feet - - - -
- 59 dB at 400 feet - - - -



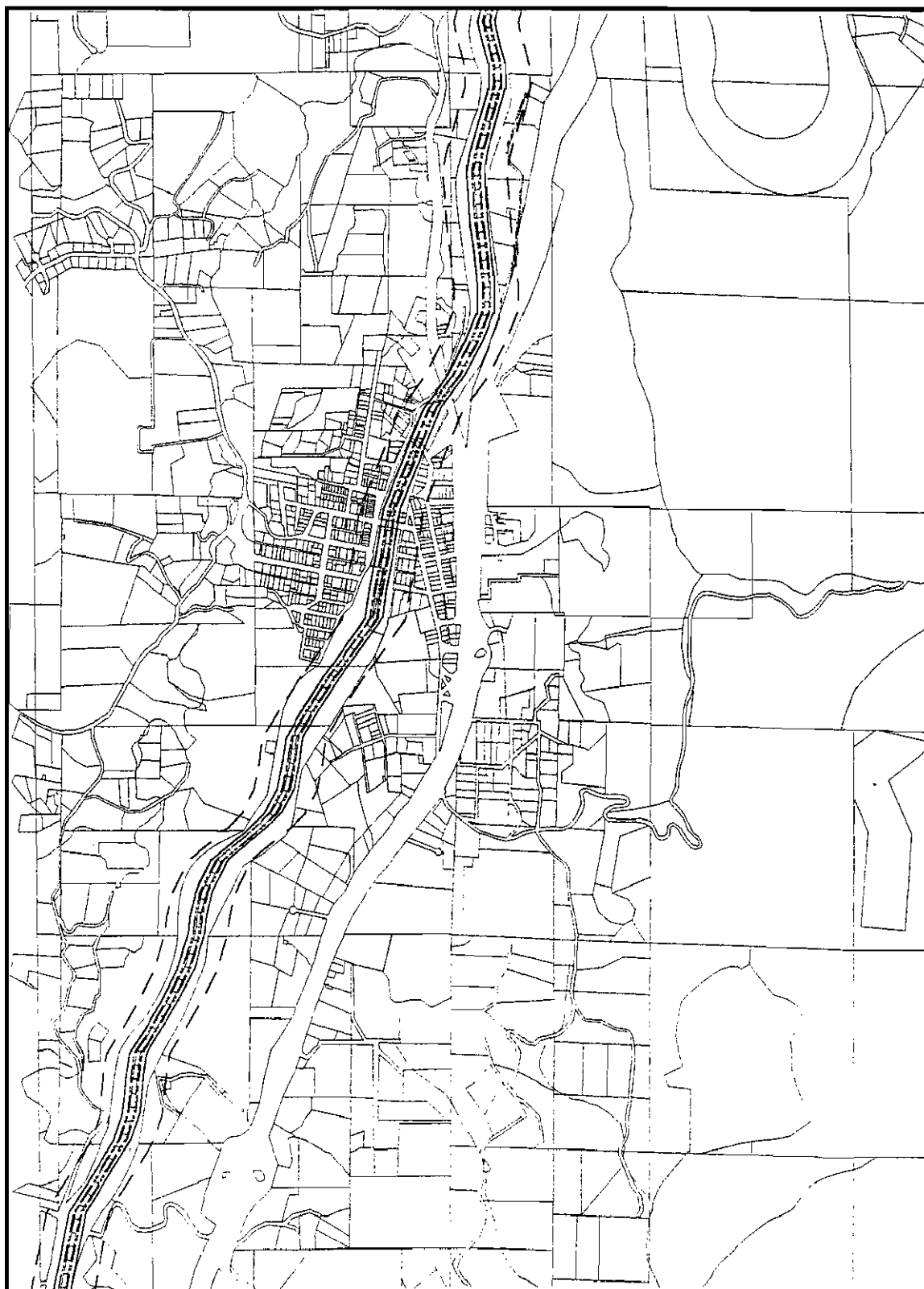
0 500 1000 2000 feet

Scale

Produced for California State University, Chico  
in Cooperation with the Geographic Information Center  
Cartography by Kent Johanns

Figure 4-5

# Railroad Noise Contours



## Legend

- 70 dB at 50 feet
- 65 dB at 100 feet
- . - . 55 dB at 400 feet
- ==== Railroad

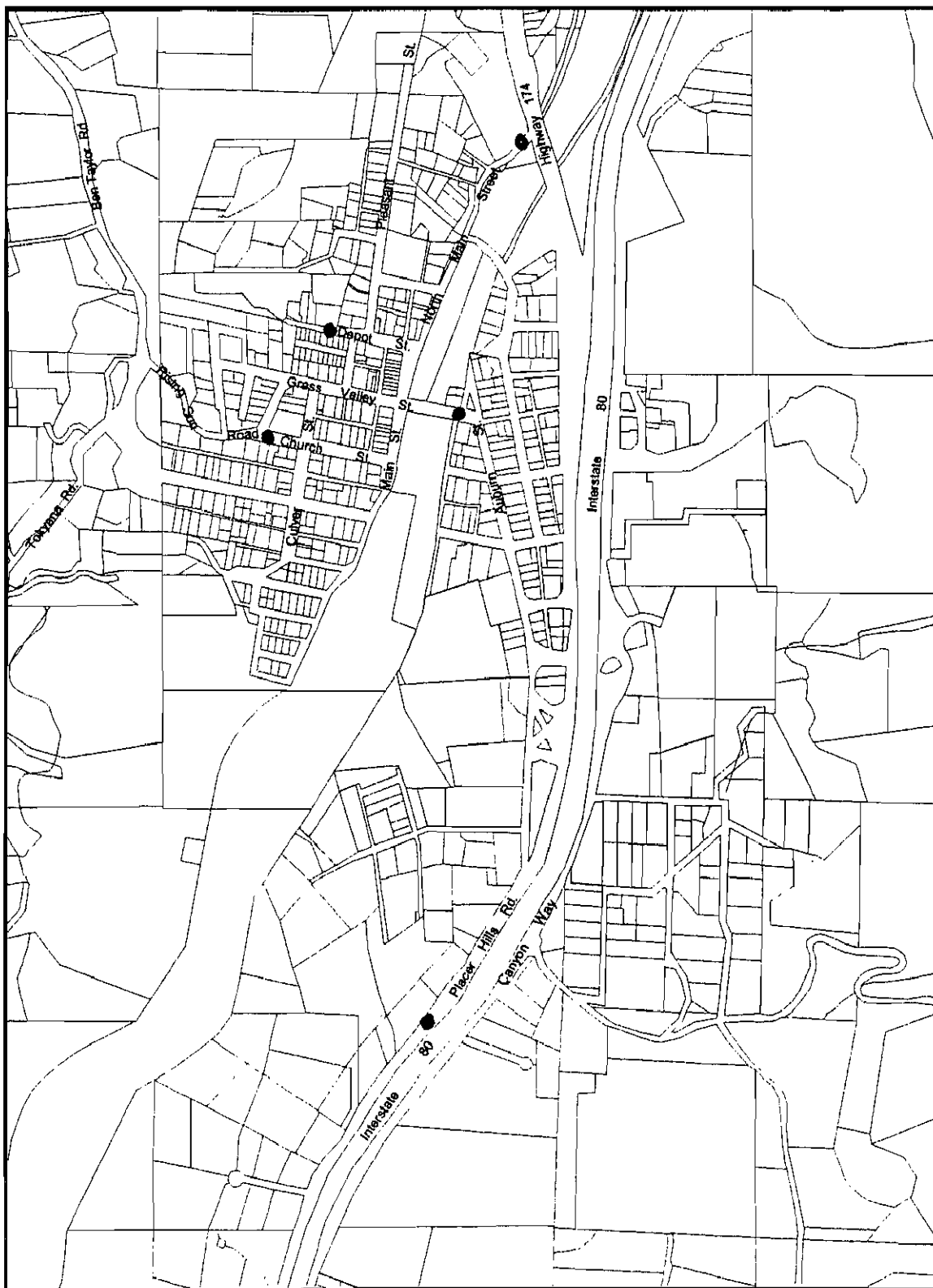


0 500 1000 2000 feet

## Scale

Produced for California State University, Chico  
in Cooperation with the Geographic Information Center  
Cartography by Kent Johanns

**Figure 4-6**  
**Noise Monitoring stations**



**Scale**  
0 1000 2000 feet  
1 inch = 1000 feet



Produced for California State University, Chico  
in Cooperation with the Geographic Information Center  
Cartography by Kent Johanna

The purpose of the traffic noise level measurements was to determine the accuracy of the FHWA model in describing the existing noise environment within the Plan Area. Noise measurement results were compared to the FHWA model results by entering the observed traffic volumes, speed and distance as inputs to the FHWA model. The results of the traffic noise measurements are summarized in Table 4-1.

**Table 4-1  
Comparison of FHWA Model To Measured Noise Levels**

<b>Location / Roadway</b>	<b>Distance (feet)</b>	<b>Measured Leq</b>	<b>Modeled Leq</b>	<b>Difference dB</b>
North Main Street / Hwy 174	75	66	68	2
Placer Hills Road / I - 80	150	69	70	1
Auburn Street	50	63	63	0
Depot Street	25	63	62	-1
Church Street	50	63	63	0

## **Railroads**

Railroad activity in the Plan Area includes freight and passenger activity on the eastbound and westbound Southern Pacific Transportation Company (SPTCo) tracks. With the merger of Union Pacific and Southern Pacific Railroads, potential increases in activity may occur.

SPTCo officials from the Roseville Dispatcher's Office report that approximately 8 freight and 4 passenger train operations per day occur on SPTCo tracks in the Plan Area. The freight trans are distributed equally on the eastbound and westbound tracks on a random basis throughout the day. Passenger train operations are scheduled to pass through the study area during daytime hours. Measurements taken on Auburn Street related to the rail line show a Ldn of 63 dB at 100 feet from the rail line and 60 dB at 200 feet from the tracks.

## **4.4 Noise Prediction Methodology**

### **4.1.1 Traffic Noise**

#### **Highway Traffic Noise Prediction Model**

The Federal Highway Administration *Highway Traffic Noise Prediction Model* (FHWA RD-77-108) is the preferred traffic noise prediction methodology. The CALVENO standardized noise emission factors must be used (published in FHWA-CA-TL-84/13, "California Vehicle Noise Emission Levels"). Any form of the FHWA Model may be used, such as manual calculation and versions for programmable calculators and computers,

including STAMINA.

Noise barrier insertion loss shall be calculated using the FHWA Model methodology. The effective center frequency of the noise sources shall be assumed to be 550 Hz. Source heights of 0, 2, and 8 feet above the roadway center line shall be assumed for autos, medium trucks and heavy trucks, respectively.

### **Noise Sensitive Receiver**

Noise sensitive receiver locations are assumed to be the backyards of single-family dwellings, and the patios and balconies of multi-family dwellings. The exterior receiver height shall be assumed to be 5 feet above back yard or patio elevation for ground-floor receivers, and 4 feet above balcony elevation for upper-floor receivers. The exterior ground-floor receiver shall be placed 10 feet from the building facade. The exterior upper-floor receiver shall be placed midway from the building facade to the edge of the balcony, and a correction factor of +2 dB shall be applied to account for reflections from the building facade.

For multi-family developments, common outdoor activity areas are also considered to be noise sensitive receiver locations. The assumed exterior receiver height is 5 feet above ground level, and the assumed receiver location is normally in the center of the recreation area.

### **Traffic Noise Attenuation**

Traffic noise attenuation with distance for ground level receivers should be consistent with an acoustically “soft” site, at 4.5 dB attenuation per doubling of distance. Noise attenuation for receivers and building facades at upper floors, and for receivers overlooking the roadway, should be consistent with an acoustically “hard” site, at 3 dB attenuation per doubling of distance. These assumptions may be modified on the basis of on-site noise measurements at proposed receiver locations and elevations.

Noise measurements for traffic noise analysis should include at least one 15-minute sample of daytime traffic noise levels (including the Leq value) under free-flowing traffic conditions, with a concurrent traffic count. Nighttime traffic noise levels may be estimated from 24-hour noise measurement data or published hourly traffic distribution data. For major arterials and highways, continuous hourly noise measurements over a 24-hour period are recommended to describe the effective day/night traffic distribution and to supplement the 15-minute sample(s). Noise measurement sites should be selected to represent proposed receiver locations and representative sound propagation conditions.

### **Traffic Volume**

Existing traffic volume, truck mix and day/night distribution should be obtained from the City of Colfax, Placer County Department of Public Works or Caltrans as appropriate. Projected future traffic volume may be obtained from those agencies or the project traffic consultant. Traffic speed shall be assumed to be the posted or projected design speed, unless

shown otherwise by observation or noise measurements.

#### 4.4.2 Railroad Noise

The preferred method of prediction railroad noise exposure is to calculate Ldn values at the proposed receiver locations based upon on-site single event and cumulative noise level measurements, assuming noise attenuation of 4.5 dB per doubling of distance for all receiver elevations. Alternative methods include the "Simplified Procedure for Developing Railroad Noise Exposure Contours," prepared by Jack W. Swing of the California Office of Noise Control, and the more detailed procedures prescribed in the *Assessment of Noise Environments Around Railroad Operations*, Wyle Research Report No. WCR 73-5.

Day/night distribution of railroad freight operations may be assumed to be uniform over a 24-hour day, unless otherwise indicated by noise measurements or information from the railroad company. Passenger train operations should be distributed according to the published schedules. The numbers and distribution of freight operations may be obtained from the railroad company dispatcher.

Railroad noise measurements should include a representative number of single event noise levels from freight and passenger operations. Noise levels recorded over a 24-hour period are normally sufficient. The data collected should include the Sound Exposure Level (SEL) and maximum sound level (Lmax) due to the passage of the train, and a notation of whether a warning horn or whistle was used. The noise levels due to bells at rail crossings should also be described.

#### 4.5 Techniques for Noise Control

Any noise problem may be considered as being composed of three basic element:

- the noise source
- a transmission path
- a receiver

Local control of noise sources is practical only with respect to fixed sources (e.g. industrial facilities, outdoor activities, etc.), as control of vehicular sources is generally preempted by federal or state law. Control of fixed noise sources is usually best obtained by enforcement of a local noise control ordinance. The emphasis of noise control in land use planning is therefore placed upon acoustical treatment of the transmission path and the receiving structures. The appropriate acoustical treatment for a given project should consider the nature of the noise source and the sensitivity of the receiver. The problem should be defined in terms of appropriate criteria, the location of the sensitive receiver (inside or outside), and when the problem occurs (daytime or nighttime). Noise control techniques should then be selected to provide an acceptable noise environment for the receiving property while remaining consistent with local aesthetic standards and practical structural and economic limits. Fundamental noise control techniques include the following:

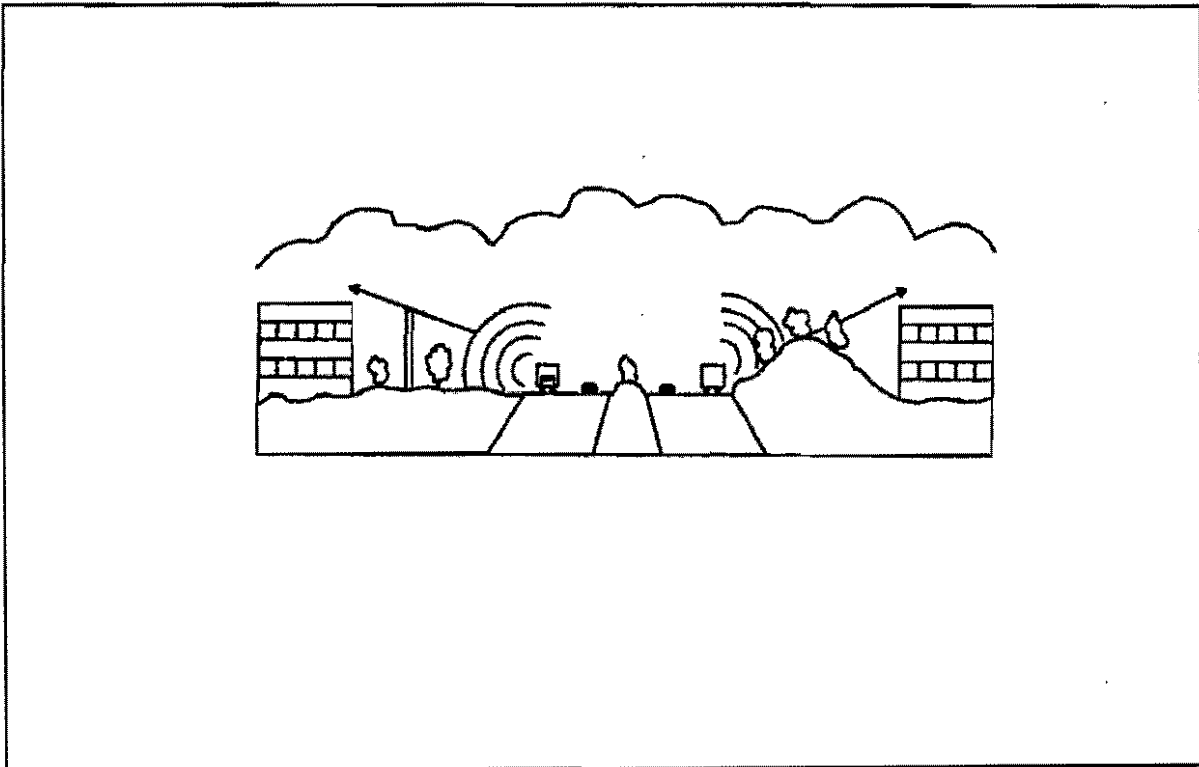
### Use of Setbacks

Noise exposure may be reduced by increasing the distance between the noise source and receiving use. Setback areas can take the form of open space, frontage roads, recreational areas, storage yards, etc. The available noise attenuation from this technique is limited by the characteristics of the noise source, but is generally 4 to 6 dB per doubling of distance from the source.

### Use of Barriers

Shielding by barriers can be obtained by placing walls, berms or other structures, such as buildings, between the noise source and the receiver. The effectiveness of a barrier depends upon blocking line-of-sight between the source and receiver, and is improved with increasing the distance the sound must travel to pass over the barrier as compared to a straight line from the source to receiver (Figure 4-7). The difference between the distance over a barrier and a straight line between the source and receiver is called the "path length difference," and is the basis for calculating barrier noise reduction.

**Figure 4-7  
Noise Barriers**



Barrier effectiveness depends upon the relative heights of the source, barrier and receiver. In general, barriers are most effective when placed close to either the receiver or the source. An intermediate barrier location yields a smaller path length difference for a given increase in barrier height than does a location closer to either source or receiver.

For maximum effectiveness, barriers must be continuous and relatively airtight along their length and height. To ensure that sound transmission through the barrier is insignificant, barrier mass should be about 4 lbs./square foot, although a lesser mass may be acceptable if the barrier material provides sufficient transmission loss in the frequency range of concern. Satisfaction of the above criteria requires substantial and well-fitted barrier materials, placed to intercept line of sight to all significant noise sources. Earth, in the form of berms or the face of a depressed area, is also an effective barrier material.

The attenuation provided by a barrier depends upon the frequency content of the source. Generally, higher frequencies are attenuated (reduced) more readily than lower frequencies. This results because a given barrier height is relatively large compared to the shorter wavelengths of high frequency sounds, while relatively small compared to the longer wavelengths of the low frequency sounds. The effective center frequency for traffic noise is usually considered to be 550 Hz. Railroad engines, cars and horns emit noise with differing frequency content, so the effectiveness of a barrier will vary for each of these sources. Frequency analysis are necessary to properly calculate barrier effectiveness for noise from sources other than highway traffic.

There are practical limits to the noise reduction provided by barriers. For highway traffic noise, a 5 to 10 dB noise reduction may often be reasonably attained. A 15 dB noise reduction is sometimes possible, but a 20 dB noise reduction is extremely difficult to achieve. Barriers can be provided in the form of walls, berms, or berm/wall combinations. The use of an earth berm in lieu of a solid wall will provide up to 3 dB additional attenuation over that attained by a solid wall alone, due to the absorption provided by the earth. Berm/wall combinations offer slightly better acoustical performance than solid walls, and are often preferred for aesthetic reasons.

Another form of barrier is the use of a depressed noise source location, such as depressed loading areas in shopping centers or depressed roadways. The walls of the depression serve to break line-of-sight between the source and receiver, and will provide absorption if left in earth or vegetative cover.

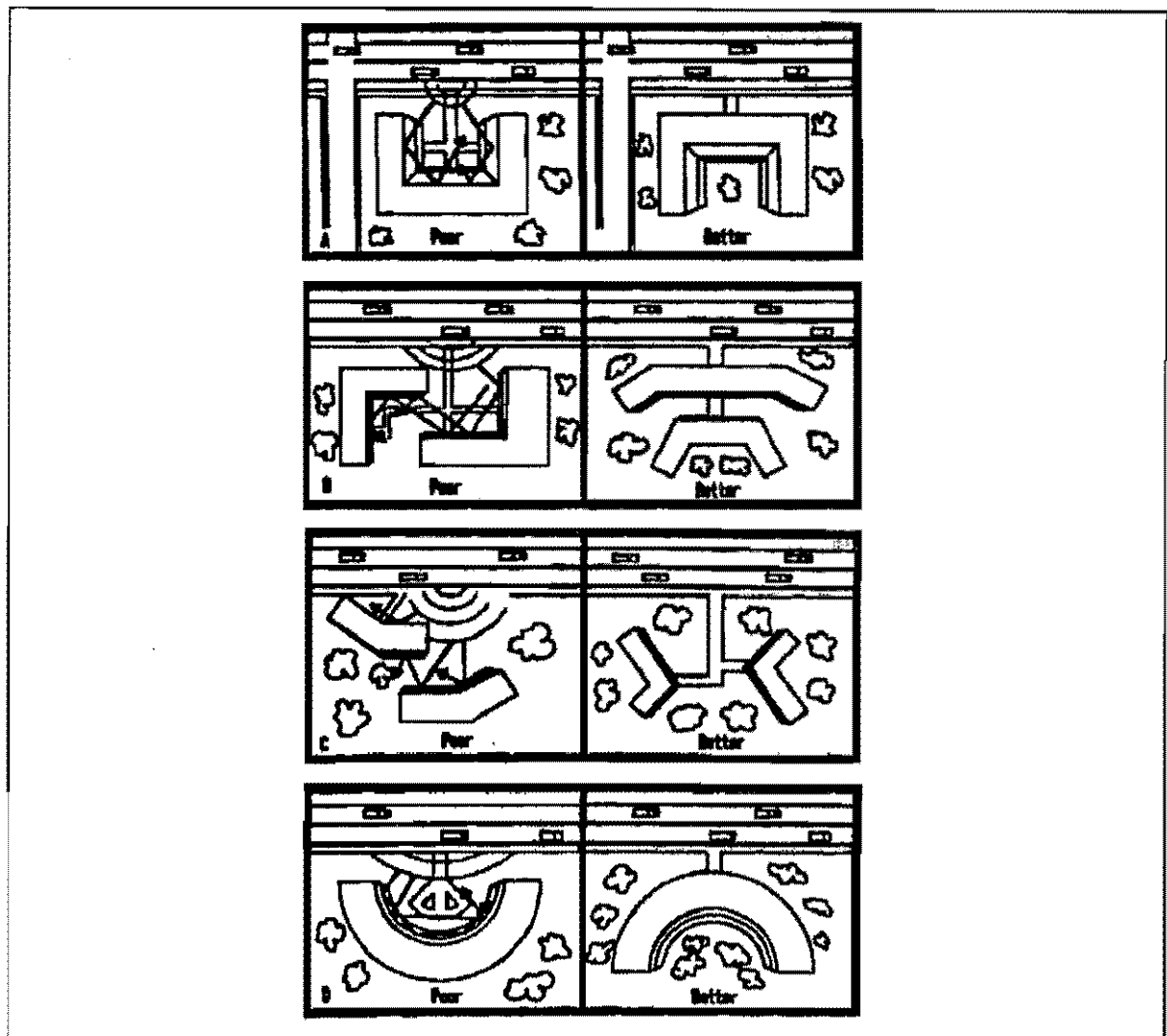
### **Site Design**

Buildings can be placed on a project site to shield other structures or areas, to remove them from noise-impacted areas, and to prevent an increase in noise level caused by reflections. The use of one building to shield another can significantly reduce overall project noise control costs, particularly if the shielding structure is insensitive to noise. As an example, carports or garages can be used to form or complement a barrier shielding adjacent dwellings or an outdoor activity area. Similarly, one residential unit can be placed to shield

another so that noise reduction measures are often needed for only the building closest to the noise source. Placement of outdoor activity areas within the shielded portion of a building complex, such as a central courtyard, can be an effective method of providing a quiet retreat in an otherwise noisy environment. Patios or balconies should be placed on the side of a building opposite the noise source, and “wing walls” can be added to buildings or patios to help shield sensitive uses.

Where project design does not allow using buildings or other land uses to shield sensitive uses, noise control costs can be reduced by orienting buildings with the narrow end facing the noise source, reducing the total area of the building requiring acoustical treatment. Some examples of building orientation to reduce noise impacts are shown in Figure 4-8.

**Figure 4-8**  
**Building Orientation**



Another option in site design is the placement of relatively insensitive land uses, such as commercial or storage areas, between the noise source and a more sensitive portion of the project. Examples include development of a commercial strip along a busy arterial to block noise affecting a residential area, or providing recreational vehicle storage or travel trailer parking along the noise-impacted edge of a mobile home park. If existing topography or development adjacent to the project site provides some shielding, as in the case of an existing berm, knoll or building, sensitive structures or activity areas may be placed behind those features to reduce noise control costs.

Site design should also guard against the creation of reflecting surfaces which may increase on-site noise levels. For example, two buildings placed at an angle facing a noise source may cause noise levels within that angle to increase by up to 3 dB. The open end of “U”-shaped buildings should point away from noise sources for the same reason. Landscaping walls or noise barriers located within a development may inadvertently reflect noise back to a noise-sensitive area unless carefully located (Figure 4-9). Avoidance of these problems while attaining an aesthetic site design requires close coordination between local agencies, the project engineer and architect, and the noise consultant.

Another important aspect of site design is avoiding the creation of noise problems at adjacent noise-sensitive properties. For example, air conditioning units should not be placed adjacent to living areas of adjoining residences unless adequate shielding is provided. Swimming pools and outdoor activity areas such as “tot lots” should be located away from adjoining residences, or should be adequately shielded.

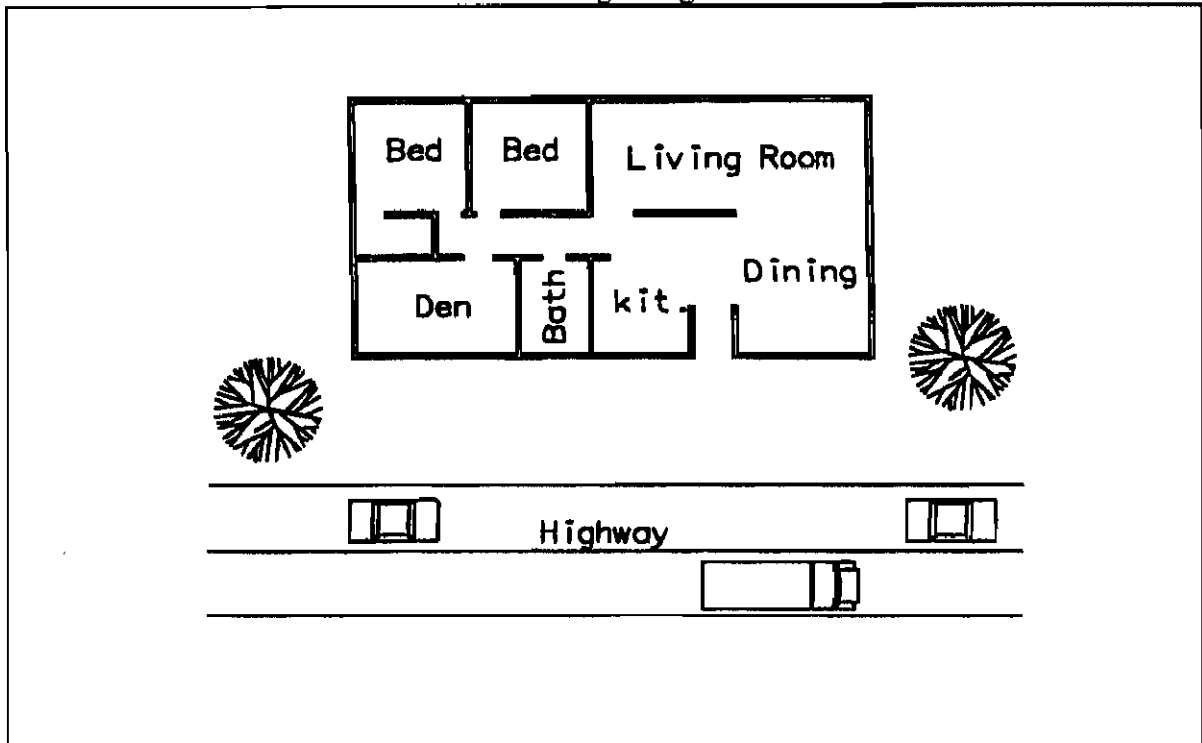
### **Building Design**

When structures have been located to provide maximum noise reduction by barriers or site design, noise reduction measures may still be required to achieve an acceptable interior noise environment. The cost of such measures may be reduced by placement of interior dwelling unit features. For example, bedrooms, living rooms, family rooms and other noise-sensitive portions of a dwelling can be located on the side of the unit farthest from the noise source (Figure 4-10).

Bathrooms, closets, stairwells and food preparation areas are relatively insensitive to exterior noise sources, can be placed on the noisy side of a unit. When such techniques are employed, noise reduction requirements for the building facade can be significantly reduced, although the architect must take care to isolate the noise impacted areas by the use of partitions or doors.

In some cases, external building facades can influence reflected noise levels affecting adjacent buildings. This is primarily a problem where high-rise buildings are proposed, and the effect is most evident in urban areas, where an “urban canyon” may be created. Bell-shaped or irregular building facades and attention to the orientation of the building can reduce this effect.

**Figure 4-9  
Building Design**



### **Noise Reduction by Building Facades**

When interior noise levels are of concern in a noisy environment, noise reduction may be obtained through acoustical design of building facades. Standard residential construction practices provide 12-15 dB noise reduction for building facades with open windows, and 20-25 dB noise reduction when windows are closed. Thus a 20 dB exterior-to-interior noise reduction can be obtained by the requirement that building design include adequate ventilation systems, allowing windows on a noise-impacted facade to remain closed under any weather condition.

Where greater noise reduction is required, acoustical treatment of the building facade is necessary. Reduction of relative window area is the most effective control technique, followed by providing acoustical glazing (thicker glass or increased air space between panes) in low air infiltration rate frames, use of fixed (non-movable) acoustical glazing or the elimination of windows. Noise transmitted through walls can be reduced by increasing wall mass (using stucco or brick in lieu of wood siding), isolating wall members by the use of double- or staggered- stud walls, or mounting interior walls on resilient channels. Noise control for exterior doorways is provided by reducing door area, using solid-core doors, and by acoustically sealing door perimeters with suitable gaskets. Roof treatments may include the use of plywood sheathing under roofing materials.

Standard energy-conservation double-pane glazing with an 1/8" or 1/4" air-space is not considered acoustical glazing, as its sound transmission loss for some noise sources is actually less than that of single-pane glazing.

Whichever noise control techniques are employed, it is essential that attention be given to installation of weatherstripping and caulking of joints. Openings for attic or subfloor ventilation may also require acoustical treatment; tight-fitting fireplace dampers and glass doors may be needed in aircraft noise-impacted areas.

Design of acoustical treatment for building facades should be based upon analysis of the level and frequency content of the noise source. The transmission loss of each building component should be defined, and the composite noise reduction for the complete facade calculated, accounting for absorption in the receiving room. A one-third octave band analysis is a definitive method of calculating the A-weighted noise reduction of a facade.

A common measure of transmission loss is the Sound Transmission Class (STC). STC ratings are not directly comparable to A-weighted noise reduction, and must be corrected for the spectral content of the noise source. Requirements for transmission loss analysis are outlined by Title 24 of the California Code of Regulations.

### **Use of Vegetation**

Trees and other vegetation are often thought to provide significant noise attenuation. However, approximately 100 feet of dense foliage (so that no visual path extends through the foliage) is required to achieve a 5 dB attenuation of traffic noise. Thus the use of vegetation as a noise barrier should not be considered a practical method of noise control unless large tracts of dense foliage are part of the existing landscape.

Vegetation can be used to acoustically "soften" intervening ground between a noise source and receiver, increasing ground absorption of sound and thus increasing the attenuation of sound with distance. Planting of trees and shrubs is also of aesthetic and psychological value, and may reduce adverse public reaction to a noise source by removing the source from view, even though noise levels will be largely unaffected. It should be noted, however, that trees planted on the top of a noise control berm can actually slightly degrade the acoustical performance of the barrier. This effect can occur when high frequency sounds are diffracted (bent) by foliage and directed downward over a barrier.

In summary, the effects of vegetation upon noise transmission are minor, and are primarily limited to increased absorption of high frequency sounds and to reducing adverse public reaction to the noise by providing aesthetic benefits.

### **Sound Absorbing Materials**

Absorptive materials such as fiberglass, foam, cloth and acoustical tiles or panels are used to reduce reflections or reverberation in closed spaces. Their use in exterior

CITY OF COLFAX  
HILLSIDE DEVELOPMENT GUIDELINES

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Statement of Intent:

These guidelines have been prepared to assist the development community by providing the preferences of the City of Colfax for the use of and design parameters for development of sloped property. The City encourages adherence to these guidelines; however, deviation may be approved by the City if, in the opinion of the City, reasonable and justifiable alternatives are proposed.

environmental noise control may reduce reflections between parallel noise barriers or other reflective surfaces. Maintenance of absorptive materials used outdoors may be difficult, as most such materials are too easily damaged by sunlight and moisture. Their application as an outdoor noise control tool is limited to special cases where the control of reflected noise is critical and where the material is sufficiently durable.

#### **4.6 Noise Issues**

The following issue and concern identified by the Planning Commission need to be addressed:

- The railroad and Interstate 80 bisect the City creating a continual objectionable noise source.

#### **4.7 Findings**

The following findings are to the above issues and concerns:

- Objectionable noise from transportation facilities can have a significant potential for impact on public health and welfare.
- Future development along railroad lines and highways could cause significant noise problems.
- Some land uses in Colfax are not currently compatible with existing noise levels and activities, i.e. residential land uses along the railroad.

#### **4.8 Noise Goals, Policies and Implementation Measures**

**Goals 4.8.1** Prevent and minimize noise sources to ensure the health and safety of the City's residents and visitors.

**Policy 4.8.1.1** Reduce outdoor noise levels in existing residential areas where economically and aesthetically feasible.

**Policy 4.8.1.2** Correct or prevent point source noises that have been demonstrated to be annoying to near by residents.

#### **Implementation Measures**

**4.8.1.A** Actively enforce the California Vehicle Code sections relating to adequate vehicle mufflers and modified exhaust systems.

**4.8.1.B** Periodically review and update the Noise Element to ensure that noise exposure information and specific policies are consistent with changing

conditions within the community and with noise control regulations or policies enacted after the adoption of this Element.

**Goal 4.8.2** Ensure that new development conforms to City noise level standards.

**Policy 4.8.2.1** Locate new noise sensitive land uses away from noise sources unless mitigation measures are included in development plans.

**Policy 4.8.2.2** Plan and design new streets or other public facilities to minimize noise in adjacent areas.

### **Implementation Measures**

**4.8.2.A** Establish buffer areas between sensitive land uses and noise sources.

**4.8.2.B** Require noise mitigation measures when new residences are built in proximity to major transportation facilities.

**4.8.2.C** Establish noise analysis procedures in the project review and building permit process.

**4.8.2.D** Develop and utilize procedures to ensure that noise mitigation measures required pursuant to an acoustical analysis are implemented in the project review and building permit processes.

**4.8.2.E** Enforce the State Noise Insulation Standards (California Code of Regulations, Title 24) and Chapter 35 of the Uniform Building Code (UBC).

**4.8.2.F** Locate recreational activities that have a potential to cause excessive noise away from noise sensitive land uses.